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Pandemic influenza planning: Shouldn't swine and poultry workers be included?

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Abstract

Recent research has demonstrated that swine and poultry professionals, especially those who work in large confinement facilities, are at markedly increased risk of zoonotic influenza virus infections. In serving as a bridging population for influenza virus spread between animals and man, these workers may introduce zoonotic influenza virus into their homes and communities as well as expose domestic swine and poultry to human influenza viruses. Prolonged and intense occupational exposures of humans working in swine or poultry confinement buildings could facilitate the generation of novel influenza viruses, as well as accelerate human influenza epidemics. Because of their potential bridging role, we posit that such workers should be recognized as a priority target group for annual influenza vaccines and receive special training to reduce the risk of influenza transmission. They should also be considered for increased surveillance and priority receipt of pandemic vaccines and antivirals.

Keywords: Influenza; Zoonoses; Occupational exposure; Communicable diseases; Emerging; Agriculture

Many nations have drafted pandemic influenza plans. Like the US national strategy, these plans are designed "to decrease health impacts including severe morbidity and death" and to minimize the "societal and economic impacts" of a pandemic [1]. However, planners have given little attention to workers who may be at very high risk of zoonotic influenza virus infection, namely those daily exposed to thousands of swine or poultry in modern animal confinement facilities. Considering recent research findings, we posit that failing to include swine and poultry workers in influenza prevention plans could result in an increased probability of generating novel viruses, acceleration of pandemic morbidity and mortality among humans in rural communities, reduction in protein supplies, and exacerbation of a pandemic's tremendous economic impact. We present these points from a United States perspective but they may have application for other nations as well.

1. Influenza pandemics and concomitant epizootics in swine and domestic birds

Influenza is a zoonotic disease that often involves cross-species viral infections between domestic swine, avian species, and man. The 1918, 1957, and 1968 pandemic influenza viruses all had structural components from an avian influenza virus [2]. During the 1918 pandemic, a concomitant

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Table 1
Recent avian influenza outbreaks that have infected man

Years	Avian influenza A type	Country	Number of human infections	Number of human deaths
1997	H5N1	Hong Kong	18	6
1999	H9N2	Hong Kong	2	
2002	H7N2	Virginia	1	
2003	H5N1	Hong Kong	2	1
2003	H7N7	The Netherlands and Belgium	89	1
2003	H9N2	Hong Kong	1	
2003	H7N2	New York	1	
2004	H7N3	Canada	2	
2004	H10N7	Egypt	2	
2004/7	H5N1	Numerous	277	167

Table data derived from various World Health Organization presentations and reports (www.who.int) as of March 8, 2007.

epizootic of swine influenza spread across the US Midwest [3]. Numerous anecdotal accounts described farmers and their families developing influenza-like illnesses after contact with ill swine and episodes where swine developed symptoms of influenza after contact with ill farmers [4]. Subsequent to the 1918 pandemic, human influenza viruses have caused considerable morbidity among swine [5] and swine influenza viruses have caused occasional morbidity among humans [6,7]. While swine influenza viruses are commonly found among domestic avian species, avian influenza viruses are only occasionally detected among swine [8]. It has been fortunate that recent highly pathogenic H7N7 and H5N1 avian strains have not manifested efficient transmission from swine-to-swine [9,10]. However, like the 1918 experience, when the next pandemic virus emerges, it is possible that efficient swine-to-swine transmission of the influenza virus may occur, thus complicating control efforts.

2. Challenges posed by influenza A infections among swine and poultry workers

The most important risk factor for humans acquiring swine influenza infection is exposure to pigs. Similarly, exposure to diseased birds has been the key risk factor for numerous cases of avian influenza virus infections in man (Table 1) [11]. A number of recent US research studies have helped us better understand the epidemiology of zoonotic influenza virus infections, especially in settings where the small farm has given way to large agricultural production facilities. Olsen et al. found that modern swine workers were much more likely to have antibodies against new swine viruses as compared to non-exposed controls [12]. Myers et al. demonstrated that swine farmers, swine veterinarians, and meat processing workers who handle pork had markedly increased odds of elevated antibodies against swine H1N1 and H1N2 viruses, that was not explained by exposure to human H1 virus or human influenza vaccines [7]. The adjusted odds ratio for swine farmers having elevated antibodies to a classic swine H1N1 virus was 35.3 (95% CI: 7.7–161.8) compared to non-exposed controls. In another recent work, Ramirez et al. documented that swine workers' similar risk (OR = 30.3; 95% CI: 3.8–243.5) of elevated antibody titer to swine H1N1 virus is reduced almost to that of non-exposed controls if the workers reported using gloves during their occupational exposures [13].

We have recently validated these reports with a prospective study of 800 rural Iowans and documented serological as well as viral culture evidence of swine influenza virus infections [14]. Importantly, these infections occurred not only among swine-exposed workers, but also among their spouses who reported no direct contact with swine. The source of virus for the spouse infections is uncertain. Infections may have occurred through secondary transmission, fomite or other indirect contact. However, the spouse infections illustrate the important potential for zoonotic pathogens to move from the occupational workers to their families. It seems equally important to note that these infections may result in severe disease or death. Myers et al. recently reviewed the 50 human swine influenza infection cases in the medical literature [15], recording a case-fatality percentage of 14 percent. Hence, should a novel influenza virus emerge in a swine population, such workers have potential to introduce the virus to their family members, their medical clinic, and their communities, causing considerable morbidity.

Studies of avian influenza virus transmission among the poultry-exposed have been more technically difficult to conduct due to the poor performance and complexity of serological assays [16,17]. Serologic studies of humans exposed to diseased poultry have often been negative. However, available studies demonstrate that infections do occur. Retrospective seroprevalence studies among Hong Kong bird market workers in 1997 and 1998 showed that 10% had evidence of H5N1 infection [18]. In addition, 49% of 508 poultry cullers, as well as 64% of 63 persons exposed to H7N7 infected humans, had serological evidence of H7N7 infection following the 2003 Netherlands poultry outbreak [16]. A recent serological study of US duck hunters and wildlife biologists exposed to ducks and geese identified several subjects with elevated antibody titers against H11 viruses [19]. A controlled, 2002 cross-sectional study of US poultry-exposed veterinarians revealed serological evidence of previous infections with avian H5, H6, and H7 viruses [20]. While such epidemiological studies are relatively few, it seems clear that